

# WHALE SHARKS OF NINGALOO REEF, WESTERN AUSTRALIA: A PRELIMINARY STUDY

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## INTRODUCTION

The Whale Shark (*Rhincodon typus*) is the largest member of the shark family, achieving lengths of at least 12 metres (Compagno 1984). Its range is extensive, inhabiting tropical and subtropical seas in every ocean. It is generally sighted feeding near the surface and is easily recognised by its immense size and distinctive slatey brown dorsal surface with white spots and white underbelly. It is a suction filter feeder and has been recorded feeding on plankton, sardines, squid and cuttlefish (Gudger 1941).

It is considered to be a rare species. In over 20 years of cruising the ocean Cousteau (1970) sighted only two Whale Sharks. Gudger, of the American Museum of Natural History, made a special study of Whale Sharks, collecting records from all over the world, and by 1935 had collected 76 accounts of Whale Shark sightings (Gudger 1927, 1935, 1937, 1938, 1941). Commonly they had been impaled on the bows of steamships. Because of its docile, inquisitive nature, the Whale Shark is easily harpooned and specimens have been taken on the west coast of Mexico and in the waters of Ceylon. Fishermen have observed Whale Sharks feeding in association with large schools of Trevally (*Caranx*) species off the Seychelles, and with Bonito off Japan. It is also sighted in the Gulf of Mexico and off southern California.

On the eastern Australian coast Whale Sharks have been sighted by Cropp (1975) as far south as Montagu Island off Narooma in New South Wales. He also reports that there are aerial sightings off Queensland in January and February each year. In Western Australia there are occasional Whale Shark sightings as far south as Kalbarri. Their appearance near Ningaloo Reef has been regarded as an interesting curiosity by local fishermen at Exmouth.

The ocean currents off the coast at Ningaloo have two distinct seasonal directions. In summer there is a northerly current with water temperature of 26°C. In winter the current reverses, flowing southward as the Leeuwin current; this has been extensively studied by the CSIRO Division of Oceanography (Pearce 1985).

Coral spawning has been studied on the Western Australian coast since 1984 and related to hydrographic data (Simpson 1985). Mass spawning occurs in autumn every year. This is also the time when the coastal current reverses and the Leeuwin current starts to flow.

## METHODS

Since arriving in Exmouth in April 1982, I have recorded all personal sightings of Whale Sharks, as well as reports from interested fishermen. Since 1983, expeditions have been undertaken specifically to search for and photograph Whale Sharks. In autumn 1984 a boat considered ideal for the purpose of Whale Shark pursuit was purchased. The help of some local fishermen operating off the Ningaloo reef was enlisted.

On many occasions, the same Whale Shark was sighted several times. A separate sighting was only recorded when more than one animal was visible

simultaneously, or where for reasons of size, identifying scars or location, it was clear that a second shark had appeared.

The success of Whale Shark spotting is dependant on many factors. Sunshine and clear blue skies are important; ocean swells assist, lifting the observer; wind, waves and white water hinder. Success is much greater on gamefishing boats equipped with a 'Marlin Tower'. An experienced observer may spot a Whale Shark 200-300 metres away when conditions are perfect. The sighting of a few Whale Sharks on a day when conditions are adverse may be very significant; the same number seen on a perfect day is a poor result.

The estimated size of Whale Sharks was based on direct comparison with the known length of the boat, and also by comparative measurement where Whale Sharks have been photographed with a diver alongside or riding on its back.

The direction of the prevailing coastal current was assessed during 1986 and 1987. Water flowing through the gaps in the reef always flows seaward at all states of the tide, and is laden with silt. The direction of flow along the reef can easily be seen, as there is a sharp demarcation between the silt-laden lagoon water and the blue water outside the reef.

## RESULTS

Boating activity off Ningaloo Reef is at its greatest in June to November when Spanish Mackerel are running and Sailfish are plentiful. During 1982 — 1984 many weekends were spent on the water during these months. Whale Shark sightings were rare, with only one personal observation in July. Early experiences suggested that April/May were the best months for sightings. On my first sortie on Exmouth waters on 1st May 1982 two small Whale Sharks were sighted at the northern end of the reef; these were the first personally ever seen. Despite numerous searches, none were seen in the rest of the year.

**1983:** The first Whale Shark search was on 14 March. Accompanied by Peter Moore, I searched for 3 hours in vain and was on the point of giving up, when a huge Whale Shark surfaced right under the bow of the boat. This huge specimen seemed wider than our 5.2 metre boat, and was the first of many to be filmed. In all, 5 Whale Sharks were sighted. Two weeks later a further 7 Whale Sharks were sighted and filmed in one weekend.

**1984:** A new boat was purchased and after some delay in Perth a 3 day search on 14-16 April drew a complete blank. Despite regular trips along the reef, only one Whale Shark was seen (in July) during the rest of the year.

**1985:** Several Whale Sharks were sighted, two personally, during a game fishing competition in late January. Because of my experiences in 1983 it was decided to spend a week searching at the beginning of March. However, only one Whale Shark was sighted and bad weather curtailed searching. Rough weather prevented further searches in March. However, over the Easter weekend of 6-8 April, at least 25 Whale Sharks were sighted. Several hours were spent on each day diving and filming, almost continuously as Whale Sharks appeared one after another along the reef. Conservative estimates are 10 seen on each day. On the Monday, 5 Whale Sharks were sighted in a one hour sortie down the reef.

Table 1. 1986 DIARY

March 22 — Perfect weather, 2 Whale Sharks seen.  
March 23 — Perfect weather, 1 Whale Shark seen.  
March 25 — Perfect weather, 2 Whale Sharks seen.  
March 26 — Perfect weather, 1 Whale Shark seen.  
March 27 — Rough seas, 1 Whale Shark seen.  
March 29 — Calm early, then rough, Nil seen.  
March 30 — Sea breeze, settling, 3 Whale Sharks seen.  
March 31 — Moderate — rough seas, 1 Whale Shark seen.

April 3/4 — Coral spawning occurred on the Reef.

April 15 — Good conditions, 3 Whale Sharks seen.  
April 16 — Good conditions, 2 Whale Sharks seen.  
April 19 — Perfect conditions, 11 Whale Sharks seen.  
April 20 — Perfect conditions, 15 Whale Sharks seen.  
May 3 — Good conditions, 7 Whale Sharks seen.

1986: Whale Sharks were extensively studied from 22-31 March and again 15-20 April. During the initial period, conditions were generally excellent. Eleven Whale Sharks were seen during 8 days searching (See Table 1, 1986 Diary). During the second period 31 Whale Sharks were seen on 4 days, with 26 sighted on 19 and 20 April. Seven Whale Sharks were seen on 3 May. By 17 May, none were seen despite an extensive search in good conditions. I later learnt that Coral spawning on Ningaloo Reef had occurred on 3 and 4 April.

Table 2. 1987 DIARY

Mackerel fisherman, Glen Macintosh, did not see any Whale Sharks from early February until he ceased fishing on March 20.

March 21 — search by Bill Winchester — nil seen.  
March 21-23 - Coral spawning observed along Ningaloo Reef.  
March 28 — adverse conditions — overcast — 3 Whale Sharks seen.  
April 4 — very rough — nil seen.  
April 5 — Charter operator, George King, reported 15 Whale Sharks sighted during excursion along the reef, in good weather conditions.  
April 6 — Coral spawn slicks still evident on the surface — good conditions — 5 Whale Sharks seen.  
April 8 — Huge swell — 5 Whale Sharks seen. First clear evidence of Leeuwin current.  
April 11 — Water milky — nil seen.  
April 20 — Adverse conditions — nil seen.  
May 2 — 3 Whale Sharks seen by Bill Winchester.

1987: Weather conditions were generally poor for sightings, with overcast skies for almost the whole of April. Searches for Whale Sharks were made at least weekly to assess numbers. No Whale Sharks were seen at all by fisherman Glen Macintosh that year from January to March. Bad weather conditions and frequently rough seas hampered observations. Despite this, up to 5 Whale Sharks in a day were sighted. The sighting of 3 in terrible conditions on March 28 was quite remarkable, as they were not seen until the boat was 'on top of them' (See Table 2, 1987 Diary).

**Size:** The majority of Whale Sharks sighted were between 5 and 7 metres in length. Occasional small sharks of approximately 4 metres have been seen, and several large sharks 7-9 metres in length.

**Predators:** Despite their size, some Whale Sharks carry battle scars, probably from previous encounters with predatory sharks. Pectoral fins most frequently were damaged.



**Behaviour:** Whale Sharks have generally been spotted swimming on the surface, feeding with mouth opening and closing. They also appear to make arching movements of their backs as they progress forwards at a speed of 1-2 knots. They generally cruise parallel to the reef. On any particular day, the majority of Whale Sharks cruise in the same direction, swimming into the prevailing current. Whale Sharks can be quite inquisitive, especially the larger ones and will approach a boat or a diver. Large specimens not infrequently position themselves behind the boat taking exhaust bubbles from the outboard leg into their mouths.

**Accompanying Species:** Whale Sharks are commonly accompanied by the Black Kingfish or Cobia (*Rachycentron canadus*) a prized gamefish reaching over 1 metre in length. They invariably have numerous sucker-fish (*Remora* spp.) on their underbellies. Many of them resemble a moving reef with large schools of small fish swimming in the pressure wave in front of their mouths. Some of these fish are juvenile Trevally, in particular Golden Trevally (*Gnathanodon speciosus*).

**Leeuwin Current:** Personal observations of coastal current flows were made during 1986 and 1987. During the 1986 observation period, 22 March to 20 April, the southerly "Leeuwin" current was flowing. In 1987 however, a northerly current was flowing during all the early periods of observation. It was not until April 8 that there was clear evidence of the Leeuwin current.

## DISCUSSION

There is an extraordinary prevalence of Whale Sharks on Ningaloo Reef, and there appears to be an aggregation in autumn each year. Several theories have evolved which could explain this.

My initial theory was that they were probably breeding in the shallow waters of the reef. Some pelagic fish are known to congregate at certain times of the year to breed. This is well documented in Pink Snapper (*Chrysophrys auratus*). Schooling of roe-laden Queen Fish (*Scomberoides commersonianus*) is an annual event on Bundegi Reef in Exmouth Gulf (personal observation). In many animal species breeding occurs at locations where, and times when, food is most plentiful.

My second theory was that they were migrating. Almost all the Whale Sharks seen in April 1985 were heading north and I felt that they must be heading for warm tropical waters. However, it is now clear that the Leeuwin current starts to flow at this time of the year, and the Whale Sharks were swimming into the prevailing current. Certainly in 1986 and 1987 there was no clear pattern of movement suggesting migration.

Table 3. CORAL SPAWNING DATES

(Known & Extrapolated)

1983 — ? April 5 — ? Split  
1984 — March 25-26 (Simpson)  
1985 — March 15-16 (Simpson)  
1986 — April 3-4 Confirmed  
1987 — March 21-23 Confirmed

It was not until mid 1986 that I first learnt of the studies of coral spawning in W.A. (Simpson 1985). Coral spawning had occurred on 3 and 4 April that year and was predicted to occur on 23 March in 1987. In 1985 spawning

had occurred on 15 and 16 March at the Dampier Archipelago. Observations of Whale Sharks for these same 3 years show quite clearly that before spawning very few Whale Sharks are present, and following it they are in abundance.

Coral spawning occurs every 12 lunar months (1 lunar month = 29.53 days), usually 7-9 days after the full moon on a falling tide about 1 hour after dark. Every third year the interval is 13 lunar months, which prevents continuing precession of the event every year. It appears however that not all corals are in phase and in some years, some may spawn at the 12 month interval, others at the 13 month interval, causing a split spawning phenomenon. In W.A. coral spawning has been studied by Simpson since 1984 (Table 1).

Studies of coral spawning in Queensland show that it occurs there about 4 months earlier than on the west coast of Australia, usually in November-December. It is interesting that the Whale Sharks appear on the Queensland coast in January and February each year (Cropp 1975), following the coral spawning.

My hypothesis is that coral spawning releases a huge protein load into the water, and this gives a massive boost to the food chain causing proliferation of algae and plankton on which Whale Sharks feed. It is possible that they are also congregating to breed at a time when food is abundant.

The appearance of Whale Sharks in W.A. in March - April loosely coincides with the onset of the Leeuwin current. In 1986 the Leeuwin current was flowing from the beginning of the period of observation. However in 1987, the prevailing current along the reef was northerly, until 8 April, when an obvious southerly drift was seen. This was well after the coral spawning and well after the Whale Sharks made their appearance. It is interesting that 1987 was an "El Nino Year", with very few cyclones in northern W.A., and an atypical weather pattern. The overcast weather experienced on North-West Cape for the whole of the month of April was extremely unusual. The Leeuwin current is thought to have its origins in the western central Pacific, and is probably influenced by the "El Nino" phenomenon (Pearce 1985).

Whale Sharks are generally sighted feeding on the surface. Little is known of their movements at times of the year when they are not seen. It could be postulated that they are present in these waters all the year round, but only sighted at times when surface feeding occurs because of some event such as coral spawning.

Compagno (1984) reports that they prefer areas where the surface temperature is 21 to 25 degrees C with cold water of 17 degrees C or less upwelling into it. The continental shelf at Ningaloo is narrower than anywhere else on the coast, the 100 fathom depth averaging 8 km out to sea. However, the bottom shelves very gradually out to this depth, and then drops off steeply. Upwelling of nutrients may take place beyond these drop-offs. The Whale Sharks observed however have been in relatively shallow water, as little as 10 - 30 metres, many kilometres from the edge of the shelf.

Estimates of Whale Shark size are worthy of comment. Over 100 Whale Sharks have been sighted by me in the past 5 years. Many previous accounts may have overestimated their size, and it is clear on inspecting some underwater photographs that there is considerable distortion of size caused by the use of wide-angle lenses. It may be however that we have a population of

unusually small Whale Sharks at Ningaloo. Indeed, our Marlin are considerably smaller than on the Pacific coast of Australia.

Population surveys carried out from a boat on the surface have severe limitations. It is hoped that aerial surveys may be conducted during 1989 to confirm my conclusions. It is also planned to attempt satellite tracking of this fascinating species. The feasibility of satellite tracking of large sharks has been shown, using Basking sharks (*Cetorhinus maximus*) off the west coast of Scotland (Priede 1984).

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